CLMPTO   07/25/01

C. Styles

1. A wander generator comprising:

random number generating means for sequentially generating a random number signal comprised of a plurality of bits at a constant rate in accordance with a predetermined algorithm;

a filter unit for receiving a sequence of random number signals output from said random number generating means for performing filtering;

clock generating means for generating a clock signal;

modulating means for modulating the frequency of the clock signal generated by said clock signal generator by a signal output from said filter unit; and

setting means for setting each amplitude value for a spectrum of a signal sequence output from said filter unit such that the characteristic of wander of the clock signal having the frequency modulated by said modulating means matches a desired characteristic.

2. A wander generator according to claim 1, characterized in that said random signal generating means has a plurality of pseudo random signal generator, wherein said plurality of pseudo random signal generators combine pseudo random signals generated thereby respectively, and is configured to sequentially generate random number signals comprised of the plurality of bits at a constant speed.

3. A wander generator according to claim 1, characterized in that said filter unit includes a plurality of storage elements for storing an input signal sequence while sequentially shifting it; and calculating means for performing a product sum calculation of stored values stored in said plurality of storage elements with a plurality of coefficients.

4. A wander generator according to claim 3, characterized in that said filter unit is configured to store a random number signal sequence output from said random number generating means in said plurality of storage elements, perform the product sum calculation by means of said calculating means, and filter the random number signal sequence,

said setting means sets the plurality of coefficients in said calculating means as signals for setting respective amplitude values for spectra of the signal sequence output from said filter unit.

5. A wander generator according to claim 3, characterized in that said filter unit comprises:

data distributing means for distributing the random number signal sequence generated by said random number signal generating means into a plurality of paths having different rates from each other;

weighting means for weighting a signal sequence for each of the paths distributed by said data distributing means with a previously set coefficient

for each of the paths; and

combining means for combining the signal sequences on the respective paths weighted by said weighting means by means of a plurality of sub-band combiners comprised of a plurality of storage elements and calculating means and for outputting the result of the combination as the result of filtering, and

said setting means sets the plurality of weighting coefficients in said weighting means of said filter unit as signals for setting respective amplitude values for spectra of the signal sequence output from said filter unit.

6. (amended) A wander generator according to claim 3, characterized by further comprising initial setting means for initially setting values equivalent to stored values stored in said respective storage elements in a steady state in which the clock signal having the wander of the desired characteristic is being output to said respective storage elements included in the filter unit at least in an initial phase of operation of said apparatus through a path different from a signal input path in the steady state.

7. A wander generator according to claim 1, characterized by further comprising:

characteristic calculating means for calculating a characteristic of wander in a clock signal frequency-modulated by said modulating means based on information

including a signal set in said filter unit from said setting unit; and

characteristic display means for displaying the characteristic calculated by said characteristic calculating means.

8. A digital line tester comprising:

a wander generator unit for generating a test signal having wander; and

a wander measuring unit for evaluating a signal passing through a digital line under testing from said wander generator unit,

characterized in that:

said wander generator unit includes the wander generator according to any of claims 1 through 7; and

said tester is configured to output a test signal synchronized with a clock signal output from said wander generator.

9. A wander generator for generating a clock signal having wander which satisfies a desired time deviation characteristic, characterized by comprising:

center frequency information setting means for setting data for determining a center frequency of the clock signal;

characteristic information setting means for setting characteristic information of the desired time deviation characteristic;

a fluctuating signal sequence generator unit for

generating a fluctuating signal sequence having a power spectrum density distribution characteristic of frequency fluctuations corresponding to the desired time deviation characteristic based on characteristic information set by said characteristic information setting means;

an adder for adding data set by said center frequency information setting means to the fluctuating signal sequence output from said fluctuating signal sequence generator unit;

a direct digital synthesizer for outputting a frequency signal corresponding to an output of said adder; and

a clock signal output circuit for waveform shaping an output signal of said direct digital synthesizer to output a clock signal.

10. A wander generator according to claim 9, characterized in that said fluctuating signal sequence generator unit comprises:

noise generating means for generating a white noise signal based on a pseudo random signal;

impulse response processing means for calculating an impulse response of a transfer function for approximating a power spectrum of a white noise signal output from said noise generating means to a power spectrum density distribution characteristic of the frequency fluctuations based on the characteristic

information set by said characteristic information
setting means; and

convolution processing means for convoluting the
result of the calculation by said impulse response
processing means with the missourians white noise
signal output from the noise generating means to
generate a fluctuating signal sequence having the power
spectrum density distribution characteristic of the
frequency fluctuations.

11. A wander generator according to the claim 10,
characterized in that said impulse response processing
means corrects an impulse response with a correction
function corresponding to an error between the power
spectrum density distribution characteristic of the
frequency fluctuations and the transfer function.

12. A wander generator according to claim 10,
characterized in that said convolution processing means
preferentially performs the product sum calculation for
smaller absolute values of the result of the
calculation for the impulse response.

13. A wander generator according to claim 10,
characterized in that said impulse response processing
means is configured to perform the calculation for the
impulse response each time a white noise signal is
output from the noise generating means; and

said convolution processing means performs the
convolution processing using the result of the

calculation made each time by the impulse response
processing means.

14. A wander generator according to claim 9, characterized in that said fluctuating signal sequence generator unit comprises:

noise generating means for generating a white noise signal based on a pseudo random signal;

data distributing means for distributing noise signals output from said noise generating means into signal paths respectively in accordance with a plurality of bands into which a frequency range of a power spectrum density distribution characteristic of the frequency fluctuations is divided to output at rates corresponding to the respective bands;

weighting means for applying weights in accordance with the magnitude of spectrum of each of the bands into which the frequency band of the power spectrum density distribution characteristic is divided for the noise signals at the respective rates distributed by said data distributing means; and

combining means for combining the noise signals at the respective rates weighted by said weighting means to generate a fluctuating signal sequence having the power spectrum density distribution characteristic of the frequency fluctuations.

15. **(amended)** A wander generator according to claim 10, characterized in that said noise generating means has a plurality (m) of sets of pseudo random signal generating means for generating pseudo random codes of M sequence at initial phases different from one another, and is configured to collect outputs at predetermined stages of said respective pseudo random signal generating means to output an m-bit parallel white noise signal.

16. A digital line tester comprising:

a wander generator for generating a clock signal
having wander which satisfies a defined time deviation
characteristic;

a transmission unit for sending a digital signal
synchronized with the clock signal output from said
wander generator to a digital line under testing;

a reception unit for receiving the digital signal
returned from said digital line under testing and
restoring a clock signal of the received digital
signal;

an error measuring unit for measuring errors in
the digital signal received by said reception unit;

a time deviation measuring unit for measuring a
time deviation characteristic of the clock signal
restored by said reception unit;

a display device; and

display control means for displaying the result of
measurements of said error measuring unit and the time
deviation characteristic measured by said time

deviation measuring unit on said display unit in such a manner that it can be compared with the defined time deviation characteristic.

17. A digital line tester according to claim 16, characterized in that said wander generator is the wander generator according to any of claims 9 through 15.

18. A digital line tester comprising:

white noise generating means for generating a digital white noise signal;

a filter unit having a digital signal for storing a digital signal in a plurality of internal storage elements while sequentially shifting therein and performing product sum calculations for the contents stored in said plurality of storage element for converting a noise signal output from said white noise generating means to a noise signal of a frequency characteristic corresponding to a previously set characteristic coefficient to output the noise signal;

characteristic coefficient setting means (130) for setting arbitrary characteristic coefficient in said filter unit;

a multiplier for multiplying a noise signal output from said filter unit by an amplitude coefficient;

amplitude setting means for setting an arbitrary coefficient to the multiplier;

a frequency synthesizer for outputting a clock

signal which is phase modulated by a noise signal output from said multiplier; and

initial setting means for initially setting a noise signal sequence equivalent to the contents stored in the respective storage elements of said digital filter in a state in which a noise signal of a frequency characteristic corresponding to the characteristic coefficient is being output from said filter unit in the respective storage elements of said digital filter at least in an initial phase of operation of said apparatus.

19. A digital line tester comprising:

white noise generating means for generating a digital white noise signal;

a filter unit having a digital signal for storing a digital signal in a plurality of internal storage elements while sequentially shifting thereinto and performing product sum calculations for the contents stored in said plurality of storage element for converting a noise signal output from said white noise generating means to a noise signal of a frequency characteristic corresponding to a previously set characteristic coefficient to output the noise signal;

characteristic coefficient setting means for setting arbitrary characteristic coefficient in the filter unit;

a multiplier for multiplying a noise signal output

from said filter unit by an amplitude coefficient;

amplitude setting means for setting an arbitrary coefficient to said multiplier;

a frequency synthesizer for outputting a clock signal which is phase modulated by a noise signal output from said multiplier;

characteristic calculating means for calculating a characteristic of a noise signal output from said multiplier or a clock signal output from said frequency synthesizer based on a characteristic coefficient set by said characteristic coefficient setting means and an amplitude coefficient set by said amplitude setting means; and

characteristic display means for displaying the characteristic calculated by said characteristic calculating means.

20. A phase noise transfer characteristic analyzer comprising:

characteristic specifying means for specifying an arbitrary phase noise characteristic;

parameter calculating means for calculating a parameter required to generate a test signal of a phase noise characteristic specified by said characteristic specifying means;

test signal generating means for generating a test signal having the phase noise characteristic based on a parameter calculated by said parameter calculating

means;

first phase noise characteristic measuring means for measuring a phase noise characteristic of the test signal generated by said test signal generating means;

an output terminal for outputting the test signal generated by said test signal generating means to an external device under analysis;

an input terminal for inputting a signal output from the device under analysis which has received the test signal;

second phase noise characteristic measuring means for measuring a phase noise characteristic of a signal input from said input terminal in parallel with the measurement of the phase noise characteristic for the test signal by said first phase noise characteristic measuring means;

approximation error calculating means for calculating a difference between the phase noise characteristic specified by said characteristic specifying means and the phase noise characteristic measured by said first phase noise characteristic measuring means as an approximation error; and

virtual characteristic calculating means for correcting the phase noise characteristic measured by said second phase noise characteristic measuring means with the approximation error calculated by said approximation error calculating means to calculate a

means;

first phase noise characteristic measuring means for measuring a phase noise characteristic of the test signal generated by said test signal generating means;

an output terminal for outputting the test signal generated by said test signal generating means to an external device under analysis;

an input terminal for inputting a signal output from the device under analysis which has received the test signal;

second phase noise characteristic measuring means for measuring a phase noise characteristic of a signal input from said input terminal in parallel with the measurement of the phase noise characteristic for the test signal by said first phase noise characteristic measuring means;

approximation error calculating means for calculating a difference between the phase noise characteristic specified by said characteristic specifying means and the phase noise characteristic measured by said first phase noise characteristic measuring means as an approximation error; and

virtual characteristic calculating means for correcting the phase noise characteristic measured by said second phase noise characteristic measuring means with the approximation error calculated by said approximation error calculating means to calculate a

virtual phase noise characteristic of a signal which is output when assuming that the device under analysis has received a test signal of the phase noise characteristic specified by said characteristic specifying means,

characterized by making it possible to know the difference between the phase noise characteristic specified by said characteristic specifying means and the virtual phase noise characteristic calculated by said virtual characteristic calculating means.

21. A phase noise transfer characteristic analyzer comprising:

characteristic specifying means for specifying an arbitrary phase noise characteristic;

parameter calculating means for calculating a parameter required to generate a test signal of a phase noise characteristic specified by said characteristic specifying means;

test signal generating means for generating a test signal having the phase noise characteristic based on a parameter calculated by said parameter calculating means;

phase noise characteristic calculating means for calculating a phase noise characteristic of the test signal generated by said test signal generating means;

an output terminal for outputting the test signal generated by said test signal generating means to an

external device under analysis;

an input terminal for inputting a signal output from the device under analysis which has received the test signal;

phase noise characteristic measuring means for measuring a phase noise characteristic of a signal input from said input terminal;

approximation error calculating means for calculating a difference between the phase noise characteristic specified by said characteristic specifying means and the phase noise characteristic measured by said phase noise characteristic measuring means as an approximation error; and

virtual characteristic calculating means for calculating a virtual phase noise characteristic of a signal output when assuming that the device under analysis has received a test signal of the phase noise characteristic specified by said characteristic specifying means,

characterized by making it possible to know the difference between the phase noise characteristic specified by said characteristic specifying means and the virtual phase noise characteristic calculated by said virtual characteristic calculating means.